Angle Between Two Fission Fragments in Fission by Fast Protons

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The theoretical Monte-Carlo modeling is done of the fission fragments' relative emission angle in the fast proton fission reaction p+Th232. The results obtained are compared with the experimental data obtained from literature. The principal aim is to study the possibilities to use the experimental information on fission fragments angular distribution for testing the model codes used to describe nuclear reactions at these energies.

Dubna version of the cascade-evaporation model CEM [1] was used in the theoretical approach together with the additional block for the calculation of fission fragments' masses which used the experimental data [2]. Fragments emission angle is defined by the characteristics of all the reaction stages of the model as well as by the process of particle evaporation from the moving fission fragments. Possible fragments re-scattering in the target was also taken into account.

Experimental data were taken from two publications presenting the results of two experimental groups. The first group studied [3] fragments emission angles in p+Th232 reaction induced by protons with energies 140, 250 , 500 and 1000 MeV. The second group [4] studied fragments emission angles as a function of the emitted neutrons multiplicities in the reaction p+U238 at proton energy 475 MeV.

The comparison of the calculated results with the experiment leads to the following conclusions: The CEM code describes satisfactory both the dependence of the fragments emission angle on the incident particle energy and on the emitted neutron multiplicities. The experimental dispersions of the fragments' emission angles are larger than the theoretical ones. Detailed analysis suggests that the CEM code lacks the events with large momentum transfer to the target nucleus.

There are also reasons to believe that one should take into account additional channels of fast proton interaction with the target nucleus, which are not described in the framework of CEM code (probably direct reactions of (p,alpha) type). The present work is done to support the suggestion of measurements made [5] in the ISTC project ¹2604 .

References

1. K.K.Gudima, S.G.Mashnik, V.D.Toneev, Nucl.Phys., A401,329, (1983).
2. C.M.Zoller, A.Gavron, J.P.Lestone, M.Mutterer, J.P. Theobald, A.S.Ilinov, M.V.Mebel, IKDA 95/25, Seminar on fission "Pont d'Oye III", Castle of Pont d'Oye, Habay-la-Neuve, Belgium, 9-15 May, 1995.
3. F.Saint-Laurent, M.Conjeaud, R.Dayras, S.Harar, H.Oeschler, C.Volant, Nucl.Ph. A422, 307, (1984).
4. X.Ledoux, H.G.Bohlen, J.Cugnon, H.Fuchs, J.Galin, B.Gatty, B.Gebauer, D.Guerreau, D.Hilscher, D.Jacquet, U.Jahnke, M.Josset, S.Leray, B.Lott, M.Morjean, B.M.Quednau, G.Roschert, A.Peghaire, L.Pienkowski, R.H.Siemssen, C.Stephan, Ph.Rev. C57, 2375 (1998).
5. ISTC Project #2604,
http://www.tech-db.ru/istc/db/projects.nsf/wu/2604?OpenDocument&Highlight=0,2604

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